WSDOT/WASHINGTON STATE FERRIES

Investigation into the Circumstances Surrounding the Damage to the Propulsion Drive Motor aboard the M/V WALLA WALLA on Nov. 4, 2012 while Undergoing Maintenance at Eagle Harbor Maintenance Facility

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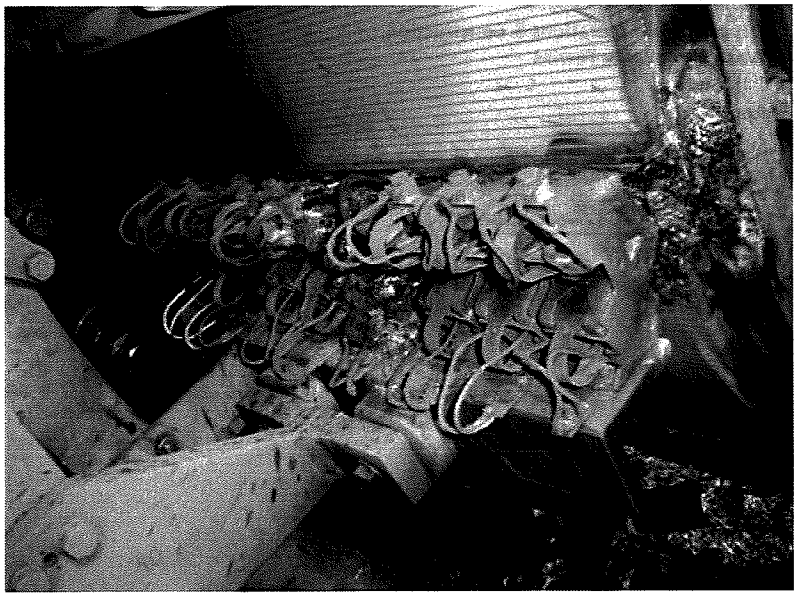
WSF Investigation Panel

2/25/2013



WALLA WALLA Drive Motor Investigation Panel

Submitted: February 25, 2013

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Executive Summary:

On Sunday, Nov. 4, 2012 at approximately 11 a.m., substantial damage occurred to the M/V *Walla Walla*'s #1A drive motor. The vessel was at the WSF Eagle Harbor Maintenance Facility at the time of the incident, undergoing post commercial shipyard and annual maintenance in preparation for the following week's U.S. Coast Guard annual inspection. Specifically, the vessel engine crew and Eagle Harbor electricians were reconditioning the commutator surface of the #2B main propulsion drive motor in motor room #2 on the #2 end of the vessel (a full description of this maintenance work is provided in the body of the investigation). This procedure required that one of the main diesel engine/generators was operating and on-line in order to provide power to the A Loop propulsion drive circuit. This allowed for the rotation of the #2A drive motor thereby permitting work on the de-energized #2B drive motor. At the time A Loop was energized, the #1A drive motor located in motor room #1 on the #1 end of the vessel was missing a number of brush assemblies and all of the exciters on the #1 end were locked and tagged out in anticipation for maintenance that was to be done in that motor room. Consequently, these missing brushes and the lock out of #1A exciter and #1 end standby exciter didn't allow for the A Loop propulsion drive circuit to operate as designed. Motor room #1 was unoccupied at the time of the event and the damage was contained within the cover and structure of the failed drive motor. Smoke filled motor room #1 and the #1A propulsion motor exhaust air temperature high alarm alerted the maintenance crew of the problem. The general alarm was sounded and the crew responded to the incident. There were no personnel injuries during this event and no environmental damage was sustained. (Photographs in Attachment 1 show the damage sustained by propulsion drive motor #1A)

The root cause of this incident was human error, which led to incorrect equipment line up and operation of the A Loop propulsion drive circuit. The following were found to be contributing factors: The vessel engine crew members were unfamiliar with the specific requirements needed for this infrequent maintenance work and there were no written procedures or check lists available. The vessel engine crew and Eagle Harbor electricians did not communicate correctly to each other the final plant component status prior to engaging in the maintenance work of the drive motor (the removal of the brushes of #1A drive motor). The Eagle Harbor electricians and

vessel engine crew unintentionally failed to communicate critical information about the plant status prior to engaging in the propulsion circuit (lock out of the exciters on the #1 end). There was a reliance on inadequate historic institutional knowledge rather than a written procedure or checklist for this infrequent complex maintenance work. The lock out/tag out (LO/TO) record sheet submissions were incomplete per the established LO/TO procedures.

The corrective action required refurbishment of the only spare drive motor for this Jumbo class vessel on an emergency basis at the repair facility in Anaheim, Calif.; removal of the damaged armature and field frames at a commercial shipyard in Seattle; reinstallation of the refurbished complete drive motor (armature and field frames), followed by extensive testing and operational sea trials still to be performed as of the date of this report. Total estimate of the costs involved in this incident and repair is approximately $3 million.

Investigative Methodology:

In accordance with WSF's Safety Management System (SMS) policy SMSM SAFE 0100 a formal investigation was chartered on Nov. 13, 2012. The investigation team was a cross departmental team of senior managers. They were:

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The investigative team used a Root Cause Analysis (RCA) structure as its investigative methodology as approved by WSDOT Risk Management. RCA is an experience-oriented, team based investigation methodology which provides a systematic process for identifying "root causes" of problems or events. After the team was formed, the panel began investigating the incident, and collecting information such as photos, statements, logs, and other data to identify and document the causal factors.

The team collected and reviewed evidence that included the following items: interviews and written statements from involved parties, emails, equipment survey reports, procedures and policies, vessel construction plans, photographs, training records and maintenance records in place and in use at the time of the incident. The investigative team also thoroughly evaluated an independent third party technical expert investigation conducted by Cadick Corporation, which

was contracted by WSF for this incident. The team met on numerous occasions to examine evidence and develop causal factors. Once the causal factors were developed, the team sought to identify the root and intermediate causes and to document them in this report.

To arrive at the root and intermediate causes the investigative team first examined the broad categories of potential problems areas, which included: structural, machinery/equipment, human and external factors. Once these areas had been reviewed for inclusion or exclusion, the team then focused on causal categories which included: design, maintenance program implementation, equipment records, procedures, human factors, operations supervision, communication, personnel training, qualifications and performance. Finally, the investigative team identified the following intermediate causes: reliance on institutional knowledge, lack of existing written procedures, lack of adequate communication between work parties, incomplete information between work parties, and inadequate problem detection/situational awareness. The results of this process are documented in the report's conclusions.

This report is accompanied by a timeline to help communicate the investigative findings. The purpose of this report is to provide a formal record of the investigation process and as a means of documenting what was learned.

Additionally, it should be noted that the Washington State Department of Labor and Industries and the U.S. Coast Guard Sector Puget Sound are also conducting independent investigations of this incident.

Findings of Facts/Timeline:

July 20, 2012

Routine visual inspections by the vessel crew noted discolored commutator surfaces on all four drive motors. The staff chief engineer created a work requisition to have an outside vendor perform a drive motor condition survey. The work requisition was reviewed and approved by the vessel's port engineer.

July 23, 2012

Walla Walla enters the scheduled commercial shipyard at Vigor Everett for dockside work, with a planned completion date of Oct. 12, 2012. The following major work items were planned to be executed:

- Vehicle deck plate repairs and steel renewal
- Gallery deck steel renewal
- Miscellaneous structural steel renewal
- Preparation and painting of car decks, pickle fork decks, stairways
- Watertight door control upgrade and maintenance
- Bilge and other piping systems renewal
- HVAC control upgrade
- Pilothouse 24 VDC upgrade

(See Attachment 2, *Walla Walla* Dockside Preservation Contract Specifications)

Aug. 20, 2012

A WSF purchase order is issued to Delta Electric Motors, Inc. for the vessel work request that was generated on July 20, 2012 to conduct the drive motor condition survey. (See Attachment 3)

Aug. 29, 2012

The #2 end motor room and drive motors are dusted with sandblast material. While the lower car deck was being sandblasted by the shipyard in preparations for painting, the containment for the #2 end drive motor ventilation ducting was damaged by the sandblasting operation. This containment damage allowed sandblast grit and dust to enter the #2 end motor room and drive motors. Vessel crews and WSF inspectors found that the #2 end motor room and drive motors were contaminated with sandblasting dust. No sandblasting dust was observed in the #1 motor room or drive motors #1A and #1B. (See Attachment 4)

Sept. 29, 2012

Vigor Everett Shipyard hires Delta Electric Motors, Inc. as a sub-contractor to clean the #2 end motor room and drive motors. This work was separate and independent of the drive motor condition survey previously arranged by WSF prior to the vessel entering the shipyard in Everett.

Oct. 5, 2012

As per the work requisition issued by the vessel's port engineer, Delta Electric Motors, Inc. completed the drive motor condition survey. This survey was completed on all four propulsion drive motors. This survey was contracted to examine the drive motor condition and commutator surfaces. Further information can be found in the body of the

investigation report. This condition survey report did not find any evidence of sandblasting grit or paint contamination.

Oct. 12, 2012

The *Walla Walla's* original contract completion date was extended and the departure from the shipyard was delayed. This delay was granted due in part to increased structural steel replacement during surface preparations for topside painting. The commercial shipyard time was subsequently extended to Oct. 29, 2012.

Oct. 23, 2012

Delta Electric Motors, Inc. submits the drive motor condition survey report to WSF based on the drive motor condition survey conducted on Oct. 5, 2012. (See Attachment 5)

Vendor report notes discoloration on all propulsion drive motor commutator surfaces due to atmospheric conditions and spring pressure of the brush assemblies.

Continued discussion between the vendor, vessel port engineer, the *Walla Walla* staff chief engineer, and Eagle Harbor electricians took place to determine the next course of action. The possible steps that were being reviewed were polishing, stoning, changing brushes, or a combination of the three.

Oct. 29, 2012

The redelivery of the *Walla Walla* from the shipyard for the second delivery date was not made. The redelivery of the vessel was delayed to a "day by day" status. This delay was accepted by WSF.

Oct. 31, 2012

The *Walla Walla* shipyard work was substantially complete and the vessel was redelivered back to WSF by Vigor Everett. *Walla Walla* was delivered via towboat to WSF Eagle Harbor Maintenance Facility at approximately 10 a.m.

Nov. 1, 2012

The *Walla Walla* layup meeting commenced between Eagle Harbor personnel, vessel engine crew, and the vessel port engineer. In response and follow up to the Delta Electric Motors, Inc. survey report, the decision to stone the propulsion drive motor commutators was made. It was decided that all four drive motor commutators would be stoned, per the recommendations of the survey report findings and follow up discussions with the vendor. The *Walla Walla* delay had impacted the remaining fleet's out of service needs; the need to return the vessel to operating status was required. Due to these time constraints it was decided that extra electricians from Eagle Harbor would be assigned for accomplishment of this task.

Nov. 2, 2012

Eagle Harbor electricians performed the drive motor pre-work insulation resistance testing of motor windings (this procedure is called "meggering," it measures the resistance of the motor to ground). The megger readings showed unacceptably low readings. Because low megger readings can indicate insulation breakdown and possible grounds, it was decided to postpone the work for 24 hours so that heaters could be applied to the drive motors in order to decrease humidity levels and, in turn, improve the condition of the drive motors. All but one brush set was removed by Eagle Harbor electricians from the #1A and #2B drive motors. This was done in preparation for that weekend's stoning. Note that there are six sets (12 rows) of brushes on each drive motor.

Nov. 3, 2012

An Eagle Harbor electrician returned to the *Walla Walla* to megger the drive motors for a second time. The megger readings improved to an acceptable limit. The stoning procedure commenced the following day, Sunday.

Nov. 4, 2012

One half week of additional maintenance out of service time had been added to the *Walla Walla's* schedule when the drive motor maintenance increased the scope of work. WSF staffed up accordingly with extra crews, work on the weekend, and allotted overtime to absorb this increased scope. The staffing was as follows:

In addition to the Eagle Harbor electricians (five), vessel engine crew including the alternate staff chief engineer (four) dispatched for that day, an extra Eagle Harbor electrician crew (three) as well as the vessel's master and staff chief engineer who was called out on overtime were dispatched to complete the work on the *Walla Walla*. A total workforce of fourteen (14) were present.

The remaining brushes were removed from the #2B drive motor by Eagle Harbor electricians, leaving the motor with no brushes.

The following timeline is compiled from statements of those involved with the incident and represents the investigation panel's best estimate of the sequence of events.

Approximately 10:15: The A Loop propulsion circuit was energized for stoning preparations by using the #3 main propulsion generator. Because the stoning operation required the shafts to turn, the master was present in the inshore pilothouse to ensure the vessel's safety while pushing the dock.

Approximately 10:49: The stoning commenced on the #2B drive motor. The shaft speed was set to 40 RPM, which held for a period of time before it decreased to 30 RPM. This decrease in RPM was noted by the vessel crew members. The speed was then increased back up to 40 RPM by adjusting the control handwheel in engineers operating station (EOS).

Approximately 10:57: #1A propulsion motor exhaust air temperature high alarm sounded in the EOS. An oiler was directed to investigate the #1 end motor room. Upon arrival at the #1 motor room, the oiler discovered smoke and arcing. The general alarm was sounded. Vessel crew suited up in firefighting gear but did not attempt to enter the #1 motor room. The staff chief engineer decided to wait to evaluate the situation until the space was safe to enter.

Approximately 10:59: The propulsion loop was secured; it was determined that there was no fire in the #1 motor room. No firefighting efforts were required. The #1 motor room was ventilated.

After approximately 45 minutes the #1 motor room was cooled and cleared of smoke. Initial inspections revealed that the #1A drive motor had sustained substantial damage to the commutator surface. The commutator surface and brushes of #1A drive motor had melted due to intense heat created by the arcing. (See Attachment 1)

U.S. Coast Guard, Sector Puget Sound was notified and a Report of Marine Accident, Injury, or Death (CG-2692) form was filed. (See Attachment 6)

WSF chain of command was notified and a WSF investigation was ordered and commenced. (See Attachment 7)

Nov. 5, 2012

Walla Walla crew and Eagle Harbor electrician statements were taken and interviews were conducted.

General Electric (GE), the original manufacturer of the drive motors, was contacted for a damage assessment.

Two Labor and Industries (L&I) investigators arrived at Eagle Harbor to investigate the *Walla Walla* drive motor damage.

Nov. 6, 2012

WSF decided to hire a third party DC motor expert to perform an independent technical investigation of the #1A propulsion drive motor damage. Cadick Corporation was chosen as the third party vendor to conduct the technical investigation.

Bob Steele, GE senior field engineer, and Steve Doman, GE sales manager, were also contracted to assess the condition of the #1A propulsion drive motor to facilitate a repair and replacement plan for the damaged drive motor.

Nov. 8, 2012

USCG Sector Puget Sound Marine Inspectors visited the vessel to assess the damage.

Nov. 13, 2012

WSF investigation was upgraded to the formal investigation status (See Attachment 8)

Third party investigator, Michael Turner from Cadick Corporation, commenced his independent investigation.

Flowchart of timeline

July 20	July 23	August 20	October 5	October 12
Walla Walla crew finds discolored commutators. A condition survey is contracted to be performed during the shipyard.	*Walla Walla* enters shipyard.	Washington State Ferries hires Delta Electric Motors, Inc. to conduct drve motor condition survey.	Delta Electnc Motors, Inc. completes motor survey for Washington State Ferries.	Shipyard period extended due to poor performance of the shipyard paint subcontractor and increased steel work.

October 23	October 29	October 31	November 1	November 2 and 3
Delta Electric Motors, Inc. issues drive motor condition report. Recommends additional motor work.	Shipyard period extended for a second time.	Shipyard work substantially completed at Vigor, Everett. *Walla Walla* delivered to Eagle Harbor Maintenance Facility.	Lay up meeting at Eagle Harbor Maintenance Facility, decision to stone commutators.	Low megger reading within drive motors. Decision to delay stoning work.

November 4
Approximately 10:57 mishap occurs.**

** For more detail see page 9 or investigation

Washington State Department of Transportation

Background:

The M/V *Walla Walla* propulsion plant consists of two drive motors per end, which are mechanically coupled to the propeller shafting in a double armature arrangement (both motors on the same shaft). The propulsion power system on this class of ferry differs from the other ferries in that it is divided into two power "loops." The two power loops are referred to as the A Loop and the B Loop. Each loop powers one motor at each end of the vessel. This is indicated in Diagram A. (See Attachment 9 for an additional simplified diagram of A Loop propulsion configuration)

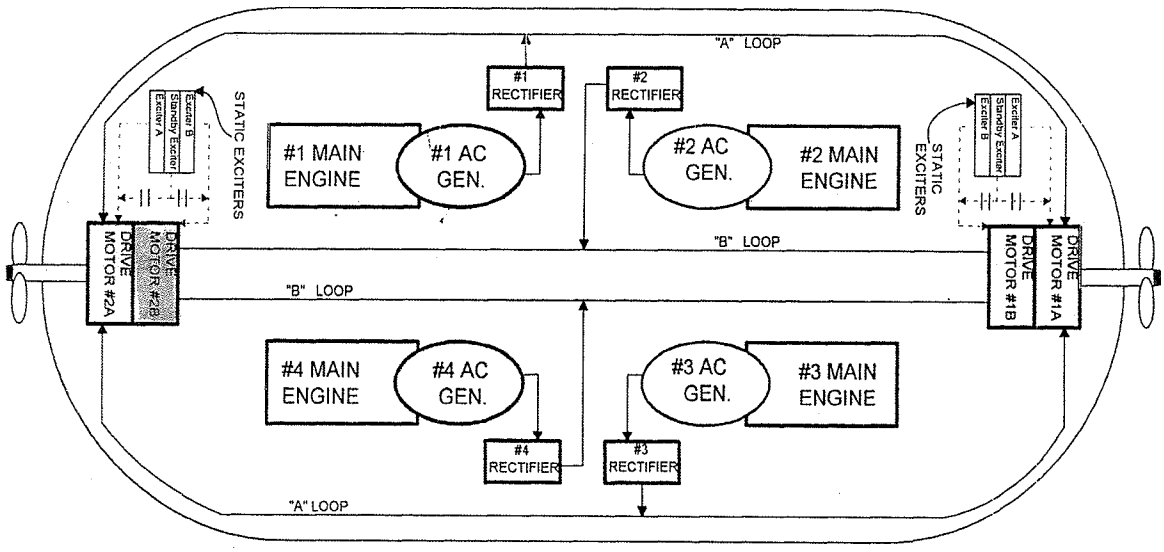


Diagram A

(Note that Diagram A depicts the loops and not the physical locations of the equipment). Each loop has two diesel generator sets supplying power to two drive motors wired in a series circuit. Each Loop (A Loop or B Loop) powers two drive motors which are physically located at opposite ends of the vessel. Motor room #1 contains drive motors #1A and #1B, and motor room #2 contains drive motors #2A and #2B. Normally the vessel will be operated with four main diesel generators running to supply power to all four drive motors. However, when deemed necessary by the operator, one to three alternators may be removed from service and the operation of the vessel can be continued at a reduced power level. The drive motors use direct current, commonly known as DC. The alternating current, commonly known as AC, is output from the main propulsion generators and is converted to DC through four separate rectifier units; from there, the DC is fed directly to each drive motor.

The vessel is operated through commands via engine order telegraph (EOT) from the Pilothouse to the engine control room. The propulsion control system provides control of the speed and direction of the ship's propellers from the engineers operating station (EOS) console by using the master control handwheel. The engineer operates this handwheel in response to the telegraph signals made from the pilothouse.

DC commutation for the *Walla Walla's* propulsion drive motor is the process of transferring currents and voltages from the drive motor carbon brushes to the copper bars of the commutator on the armature (rotor). When direct current is supplied to a winding on the armature that is subjected to a stationary magnetic field, it experiences a rotational force and resulting output torque. It is this generated torque which drives the propulsion shaft and subsequently rotates the propeller. It is imperative that the surface of the commutator (copper bars) have been cured. This curing, otherwise known as commutator film or patina, needs to be maintained in order to have good commutation. Proper film is needed to ensure the most efficient flow of current to the drive motor and to extend the life of the carbon brushes and commutator surface. (See Attachment 10 for condition charts for clarification)

The drive motors on *Walla Walla* contain 12 brush arm assemblies, seen in Figure 1 below. Each brush arm has eight brush boxes mounted to it. These are double, V-type brush boxes

containing two oppositely angled brushes to accommodate the reversing nature of the motor. (See Attachment 11 and 12 for rigging configuration)

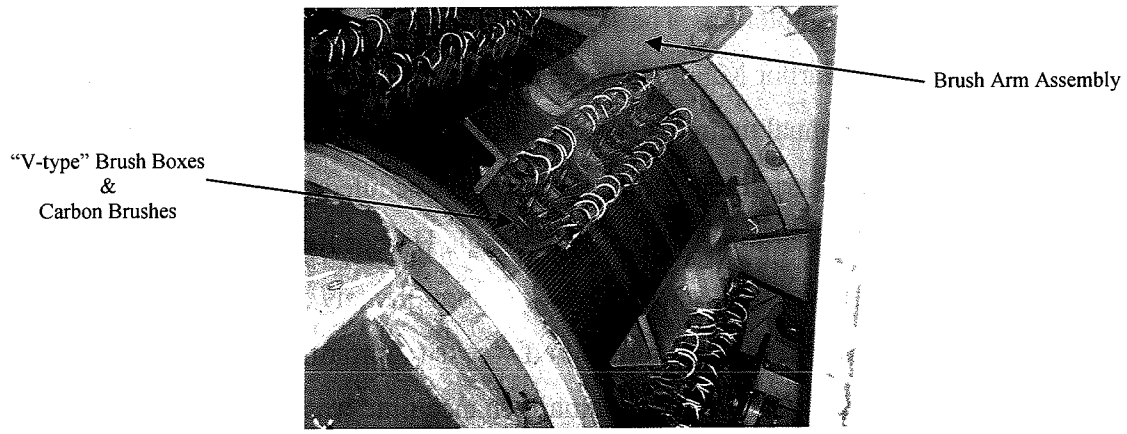


Figure 1

An outside vendor was contracted to inspect the discolored commutator film of the propulsion drive motors. Delta Electric Motors, Inc. was hired to accomplish this task. The inspection was made while the vessel was in the commercial yard at Vigor Everett. Through this inspection it was discovered that all four drive motor commutator surfaces had discoloration which would require additional maintenance. (See Attachment 5) A review of the drive motor condition report and follow up conversations with the vendor led to the decision to stone the commutators rather than hand polishing them.

There are several steps to recondition a commutator surface depending on the condition. The most severe would be to machine the surface by turning the motor and taking a light cut off of the commutator surface. The next step is to use a hand stone (an abrasive material similar to a sharpening stone) shaped to the curvature of the commutator to improve the surface finish. The final step would be to polish the commutator surface with different degrees of abrasive material (such as sandpaper to hardwood) until a mirror-like finish is achieved. The condition of the commutator surface will determine the step(s) required to achieve the mirror-like finish.

Because the vessel was located in the commercial yard, the maintenance suggested by the vendor had to be put on hold until the vessel was moved to the WSF Eagle Harbor Maintenance Facility where there would be no interference with the shipyard work.

The shipyard period originally was scheduled to conclude on Oct. 12, 2012; however, this date was delayed because of additional work discovered during sandblasting in preparation for topside painting. Additionally, the painting subcontracted by Vigor Everett had performance challenges further delaying completion. The *Walla Walla* was eventually redelivered to WSF and was towed to the Eagle Harbor Maintenance Facility on Oct. 31, 2012, where it was scheduled to commence its annual maintenance period and U.S. Coast Guard inspections. Prior to the Vigor Everett shipyard period, the *Walla Walla* was scheduled for two weeks of annual maintenance and U.S. Coast Guard inspections at the Eagle Harbor Repair Facility once the vessel was redelivered. This two week scope of work (approximately 553 scheduled Eagle Harbor work hours) was changed to two and one half weeks (approximately 873 scheduled Eagle Harbor work hours). This increase in scheduled maintenance time was added to accommodate the increase in scope of work identified in the Delta Electric Motors, Inc. condition report. The original and additional scopes of work were accommodated for by the increase in time period allowed for the repair. This increase in scope of work necessitated a schedule that included double crews working weekends and overtime.

There are two methods for plant line up for drive motor stoning on the *Walla Walla.* (See Attachment 13) The first method would be to operate only two drive motors on one loop. For example, motors #1A and #2A would be energized, permitting motors #1B and #2B to be de-energized while doing maintenance. All possible sources of excitation would be locked out and tagged out to the B Loop. This lock out/tag out would include drive motors #1B and #2B; #1 end motor standby exciter; and #2 end motor standby exciters; and #2 generator and #4 generator, A Loop alternator standby exciter, and B Loop alternator standby exciters. This would ensure that voltage or current could not be developed on B Loop.

Drive motor #1A would be operated at slow speed with the #1 propeller pulling the vessel towards the Eagle Harbor maintenance dock and drive motor #2A would be operated at slow speed, and with #2 propeller pushing the vessel into the berth. This would have required that all brushes had been installed inside both drive motors #1A and #2A. Either generator #1 or #3 could be operated to provide power to the A Loop and drive motors #1A and #2A. (See Attachment 14 for plant line up)

The second method, only to be used on an emergency basis as indicated from the original manufacturer's instruction manual (See Attachment 15), would be to reconfigure drive motor #1A's internal bus bars (See Attachment 16 and Attachment 17) so that its armature circuit was bypassed. A physical depiction of the bus bars is seen in Figure 2 below.

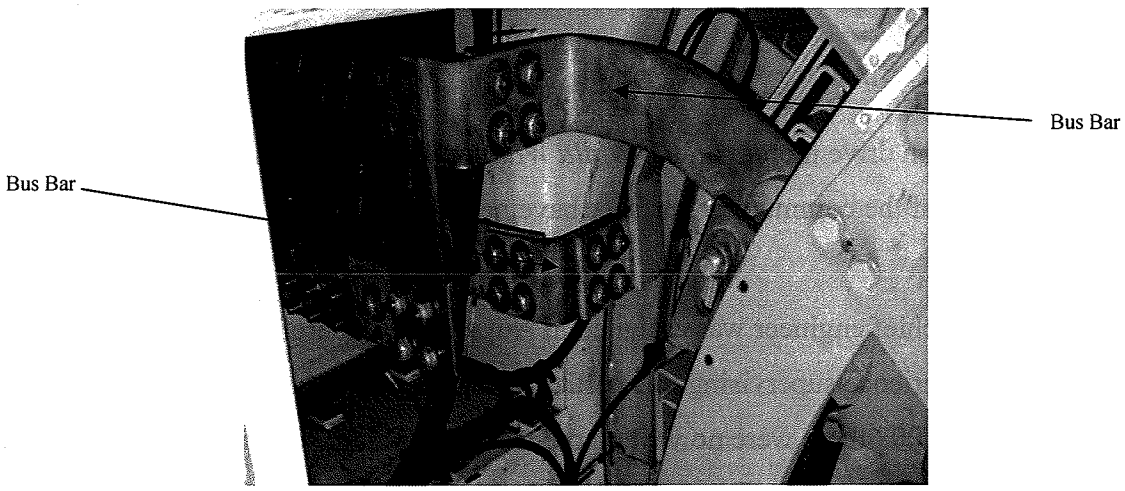


Figure 2

The reconfiguration work would have required all sources of power to A Loop to be removed first. Once these bus bars were reconfigured and the motor covers reinstalled, A Loop could be operated to perform the work of stoning drive motor #2B. The complete lock out of B Loop, including motor #1B and #2B, would still be required. Further, motor exciter #1A should also be locked out as had been done that day. The loop current that flowed through motor #2A to rotate motor #2B for stoning would also flow into motor #1A at the opposite end of the vessel. But that loop current would flow through the internal bypass shunt and not the motor armature and thus the commutator surface and brushes of motor #1A.

During the course of this investigation it was determined that neither of the two methods described above were used correctly. The propulsion plant was incorrectly configured. It was this error that caused the damage to occur on the #1A drive motor. The investigation determined that an incorrect method was used, described as follows: All but one brush set was removed from

both the #1A and #2B drive motors and #2A, #2B, and #2 end standby exciters were unlocked. This unlocking was not properly recorded in the lock out/tag out log. The plant should have been configured so that the A Loop was to be energized and B Loop would be de-energized so that stoning could be performed on the #2B motor as indicated in the first method described above. It should be noted that the stoning of a commutator is a common practice with DC motor maintenance.

The four propulsion drive motors on the *Walla Walla* were replaced in 2003, and since that installation none of the commutator surfaces have needed to be stoned.

The current staff chief engineer was assigned in August 2006, therefore, the staff chief engineer had no direct experience supervising this particular maintenance work prior to the incident on the *Walla Walla*. In 2003 there were no written procedures for plant set-up for commutator stoning. However, the technicians from General Electric had been present to oversee the drive motor commutator resurfacing. Eagle Harbor electricians regularly perform this maintenance work on the Super class vessels. It should be noted that while the commutator stoning is similar work on the Super class vessels the plant configuration is different than the *Walla Walla*.

The investigation panel determined the following significant factors in this incident. Both the vessel engineer crews and Eagle Harbor electricians assumed the plant was properly set up to stone the commutator of the #2B drive motor. Additionally, the vessel and Eagle Harbor crews did not conduct a final plant configuration walk through together as a final check to verify the plant line up before the A Loop propulsion circuit was energized. As a result, at the time of the incident, the vessel's staff chief engineer was unaware that five of the six brush sets had been removed from the #1A drive motor and the Eagle Harbor crews were not involved with the plant line up. The vessel crew was operating on institutional/historical knowledge on how to isolate the different propulsion loops. The investigation determined through a review of the LO/TO records, the unlocking of the #2 end exciters were not indicated in the LO/TO log. (See Attachment 18) The missing log entries were believed to be a procedural error as the locks would have had to be removed in order to operate the drive motors. Clarification of the exciter unlocking was verified with the crew statements gathered during the initial interviews.

When a vessel enters the Eagle Harbor Maintenance Facility, the vessel engine crews typically perform the plant line up and operation required to perform any of the various maintenance activities. Eagle Harbor crews typically perform the actual maintenance work, in this case, the stoning of the #1A drive motor.

The investigation panel determined that sandblasting and paint were not causal factors to the damage sustained to the #1A drive motor.

The following personnel were present aboard the *Walla Walla* the day of the drive motor damage:

Vessel Crews:

Cynthia Bruner, vessel master (see Attachment 19)

Bruce Cooper, staff chief engineer, a port engineer directed dispatch to oversee the drive motor work being performed on the vessel (See Attachment 20)

John Settles, alternate staff chief engineer, who was the night watch chief working days (See Attachment 21)

Allen Arnesen, chief engineer, on watch for day shift (See Attachment 22)

Raynaldo Esteban, oiler, on watch for day shift (See Attachment 23)

Stavros (Steve) Sourelos, oiler, on watch for day shift (See Attachment 24)

Eagle Harbor Crews:

Steve Carpine, vessel general foreman (See Attachment 25)

Mark LeVang, electrical lead (See Attachment 26)

Dave Coulter, journeyman

George Dimitrov, journeyman

Sergey Mogulevskiy, journeyman

Sylwester Mroczek, journeyman

Mike Gear, journeyman

Mike Ball, journeyman

Cadick Corporation was hired as a third party investigator to determine the cause of the damage to the #1A drive motor. Please see the attached report. (Attachments 27 & 28) This report concluded and confirmed mechanically that the #1A drive motor damage was due to human error as a result of incomplete plant configuration.

Conclusions:

The investigation panel found the report by the Cadick Corporation to be of great assistance in providing outside verification and a fuller understanding of the circumstances surrounding the substantial damage sustained by the *Walla Walla* drive motor on Nov. 4, 2012. The #1A propulsion drive motor still had two assemblies of twelve brush assemblies connected to the commutator when A Loop was energized. Excitation to the #1A drive motor was locked out and consequently the motor would not rotate. Nonetheless, the DC circuit was completed and the resultant current caused the two connecting brush assemblies to heat up and melt connecting metals and generate smoke and sparks. Electrical "arcs" developed and the #1A propulsion motor exhaust air temperature high alarm sounded after approximately 40 minutes of circuit connection.

No personnel were in the #1 motor room; however, had there been crew in the #1 motor room, the investigation panel concludes they would not have been exposed to the electrical arcing as the vessel crew discovered the damage wholly contained within the drive motor casing/housing. This casing was intact and not breached or significantly damaged during this incident. The investigation panel surmises that if a crew member *had* been in the #1 motor room, the incorrect propulsion system configuration would have been detected immediately and the damage to the propulsion drive motor may have been limited or minimized.

The *Walla Walla's* #1A propulsion drive motor experienced substantial damage that the panel deems preventable. The root cause of this damage was human error due to lack of situational awareness. Specifically, this lack of situational awareness led to the incorrect equipment line up and improper operation of the A Loop propulsion drive circuit.

The following were found to be contributing factors:

1. The vessel engine crew members were unfamiliar with the specific requirements needed for this infrequent maintenance work.

2. The vessel engine crew and Eagle Harbor electricians did not effectively communicate to each other the final plant component status correctly prior to engaging in the maintenance work of the drive motor.

3. The Eagle Harbor electricians and vessel engine crew unintentionally failed to communicate critical information about the plant status prior to energizing the A Loop propulsion circuit.

4. Work crews were overly reliant on inadequate historical institutional knowledge concerning this infrequent complex maintenance work. Additionally, there were no written procedures or checklists available for this infrequent complex maintenance work.

5. The lock out/tag out (LO/TO) record sheets and logbook were incomplete; specifically #2A, #2B, and #2 end standby exciters were unlocked. This unlocking was not properly recorded in the lock out/tag out log. Additionally some submissions in the log were overly vague and not in accordance with established LO/TO procedures.

The shipyard period had been delayed and there were challenges to the redelivery; however, crew fatigue was not a contributing factor with the damage on the #1A drive motor. Vessel engine crews and Eagle Harbor electricians had been working day shifts prior to the stoning.

The investigation panel concludes that while there was a strong organizational desire to return the *Walla Walla* to operational service given the delay from the commercial shipyard, the Eagle Harbor maintenance time was expanded from two weeks to two and one half weeks. The allocated time and human resources assigned were sufficient to accomplish the additional scope connected with this maintenance activity. The Cadick Corporation investigation was unaware that there was an increase in repair time allocated for the added drive motor work. Subsequently the Cadick Corporation investigation report did not take this into account when making their final conclusions and recommendations. (See attachment 28)

Recommendations:

The focus of this investigation was to explore the safety aspects of the incident, determine the root cause, identify contributing factors and make recommendations to prevent future similar occurrences. The investigation panel recognizes this incident was preventable given the human error component and recommends a number of actions for Washington State Ferries:

1. Give appropriate training prior to the specific work for infrequent complex maintenance activity.

2. Establish and follow checklists and associated written procedures for the infrequent complex maintenance activity by Feb. 25, 2013.

3. Mandate pre-work meetings prior to work being performed on vital equipment with all associated personnel (vendors, crew, maintenance department, etc.)

4. Explore the feasibility of either additional alarms or interlocks to handle the situation of a non-rotating motor with loop current flowing through it.

5. Reinforce established lock out/tag out (LO/TO) procedures, and ensure detailed entries of equipment components rather than non-specific descriptions.

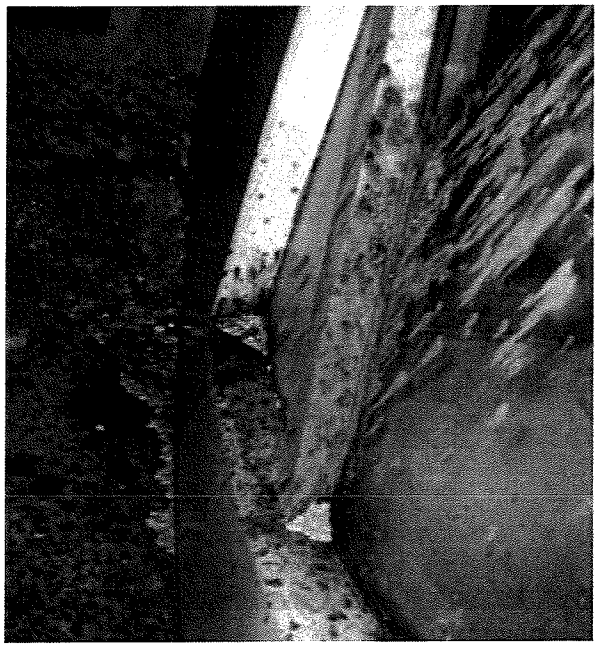
The investigation panel further recommends that this report be referred to the director, vessel maintenance, preservation and engineering, as well as human resources, for further review and consideration.

Since the investigation panel concludes sufficient time and resources were allocated to accomplish the Eagle Harbor work list, a specific recommendation about maintenance and operational planning is not proposed. However, Washington State Ferries should carefully consider maintenance needs and contingency planning when developing operational schedules. This is especially important as the WSF fleet ages and requires increased levels of maintenance.

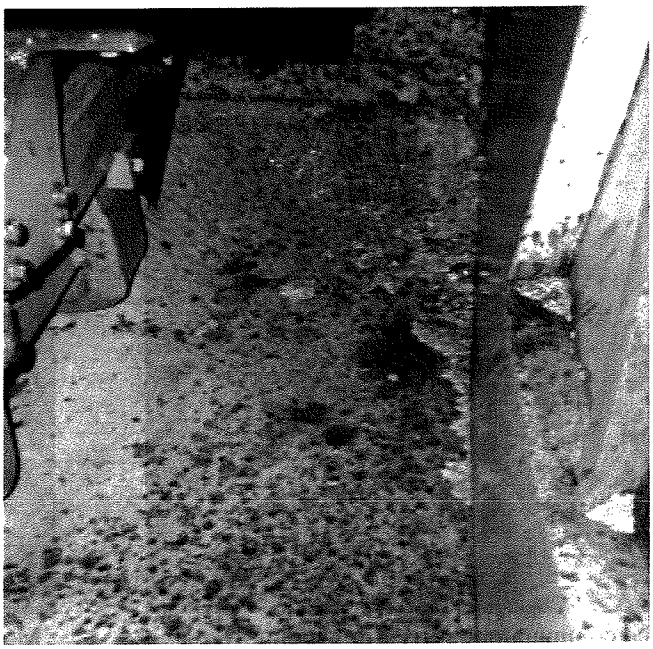
Attachments:

ATTACHMENT 1..... Drive Motor Damage and Repair Photos
ATTACHMENT 2..... Technical Specifications and Change Orders
ATTACHMENT 3..... Delta Electric Motors Purchase Order
ATTACHMENT 4..... Drive Motor Contamination Email and Photo
ATTACHMENT 5..... Delta Electric Drive Motor Condition Report
ATTACHMENT 6..... U.S. Coast Guard (2692)
ATTACHMENT 7..... Capacci Email Starting Investigation
ATTACHMENT 8..... Capacci Email Directing Formal Investigation
ATTACHMENT 9..... Diagrams of "A Loop" and "B Loop"
ATTACHMENT 10..... Commutator Condition Charts
ATTACHMENT 11..... GE Gwg 403C1236EK-Yoke & Brush Rigging Assembly
ATTACHMENT 12..... GE Gwg 40SE1047AH-Wound Frame Brush Rigging Assembly
ATTACHMENT 13..... Instructions for Plant Line Up, Method 1
ATTACHMENT 14..... Plant Line Up Diagram
ATTACHMENT 15..... Instructions for Plant Line Up, Method 2
ATTACHMENT 16..... GE Dwg 4004D1155BK – Diagram of Connections
ATTACHMENT 17..... GE Dwg 4003C1339BS – Conduit Box Assembly
ATTACHMENT 18..... Lock Out/Tag Out Log
ATTACHMENT 19..... Statement of Cynthia Bruner
ATTACHMENT 20..... Statement of Bruce Cooper
ATTACHMENT 21..... Statement of John Settles
ATTACHMENT 22..... Statement of Alan Arnesen
ATTACHMENT 23..... Statement of Reynaldo Esteban
ATTACHMENT 24..... Statement of Stavros (Steve) Sourelos
ATTACHMENT 25..... Statement of Steve Carpine
ATTACHMENT 26..... Statement of Mark Levang
ATTACHMENT 27..... Cadick Corp. Engineering Investigation Report
ATTACHMENT 28..... Cadick Corp. Follow-up Statement

Walla Walla Drive Motor Damage



Molten and spattered copper from Commutator bars in Drive Motor housing

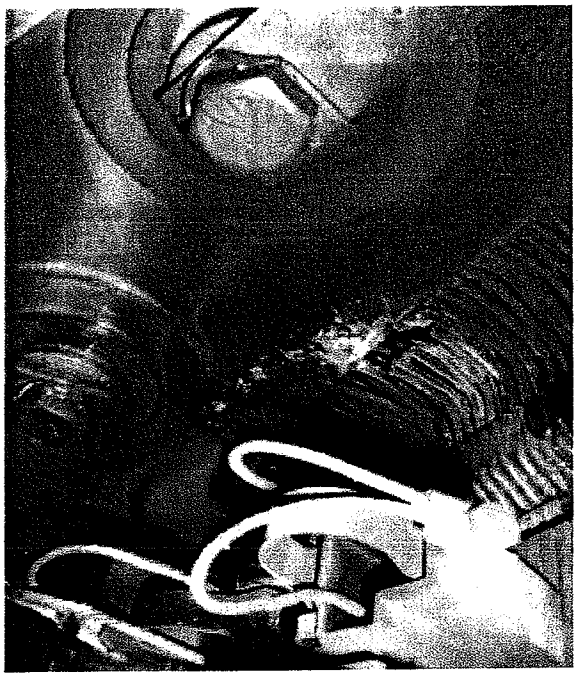


Molten and spattered copper from Commutator bars in Drive Motor housing

Burned commutator bar riser to winding connections

Damaged carbon brushes, brush pigtails, brush holders, and commutator bars

Walla Walla Drive Motor Damage



Burned commutator bar riser to winding connections

Molten copper on brush rigging

Extensive damage to brush and commutator bars

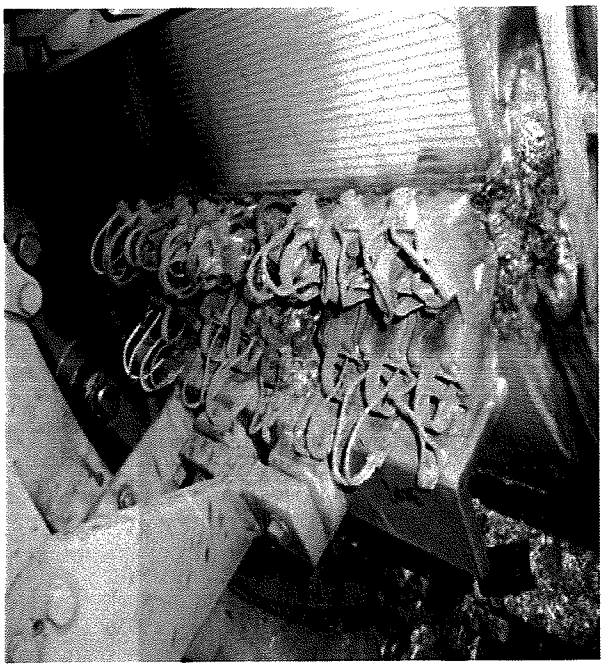
Extensive damage to brush and commutator bar

Walla Walla Drive Motor Damage

End on view of extensive damage to brush and commutator bars

Extensive damage to brush and commutator bars

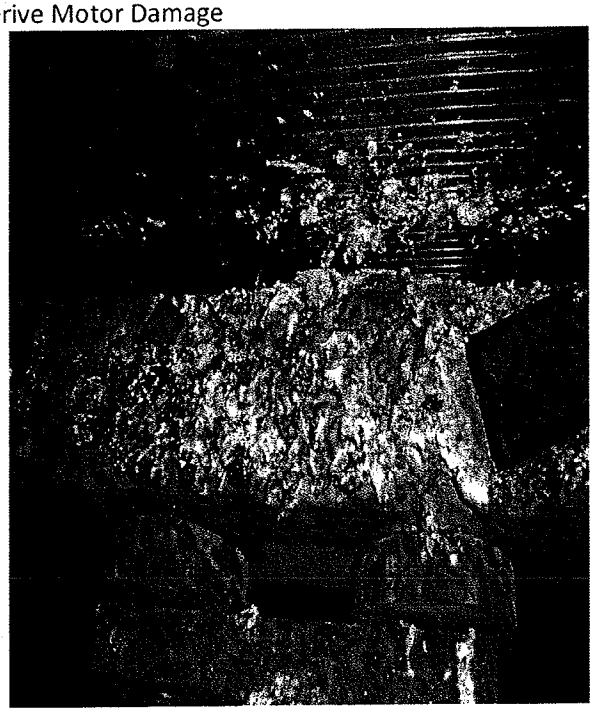
Extensive damage to brush and commutator bars



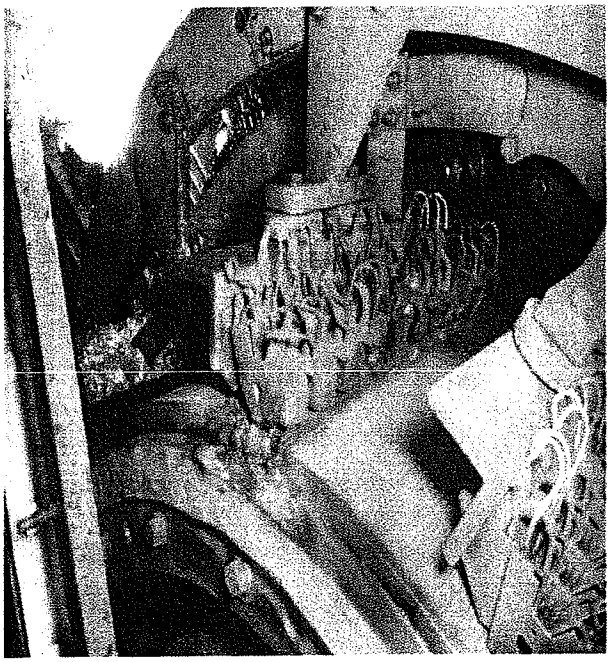
Overall view of the row of brushes that overheated arced, and caused the extensive damage to brush and commutator bars

Walla Walla Drive Motor Damage

Commutator bars adjacent to the severely damaged area, showing signs of spattered, molten copper

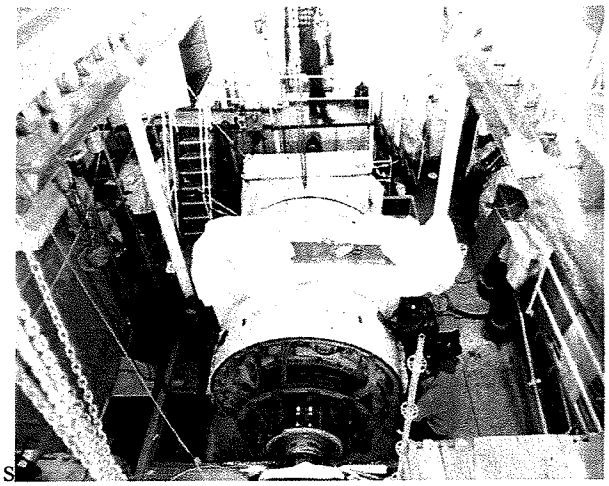


Molten and spattered copper on brush rigging and commutator bars

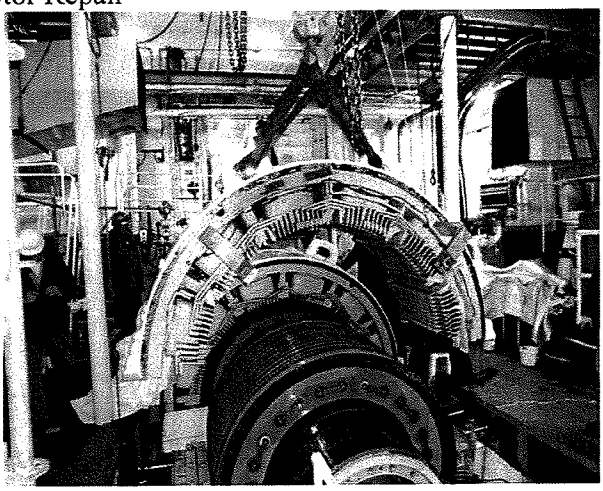


Overall view of the row of brushes that overheated arced, and caused the extensive damage to brush and commutator bars

Walla Walla Drive Motor Repair

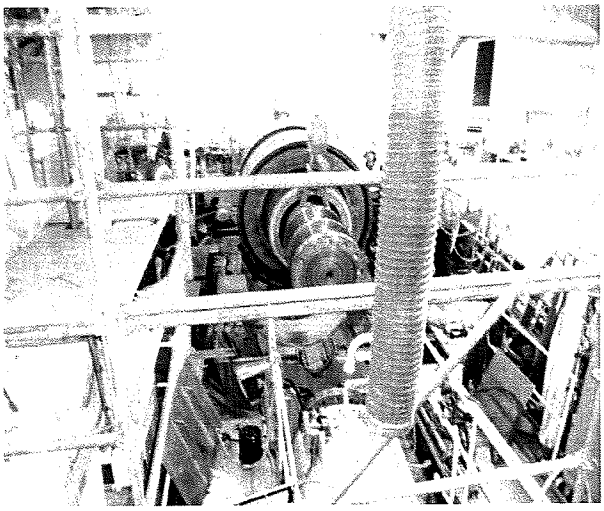


Upper field frame being prepared for removal
Vessel

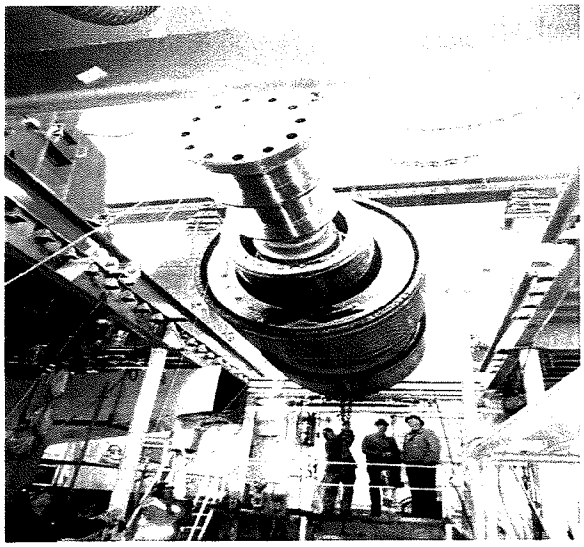


Upper field frame being lifted from drive from
motor room

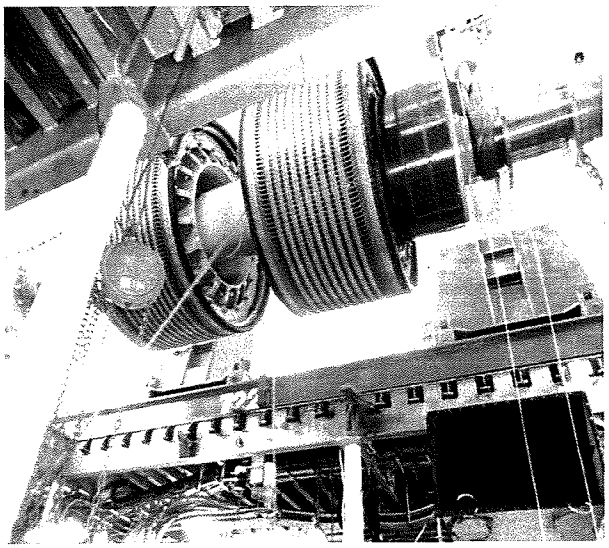
Upper field frame lifted onto car deck



Armature lifted from bearing pedestals

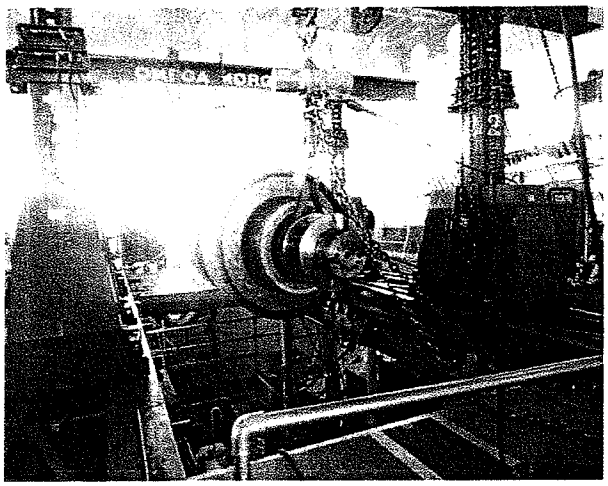


Armature lifted from drive motor room

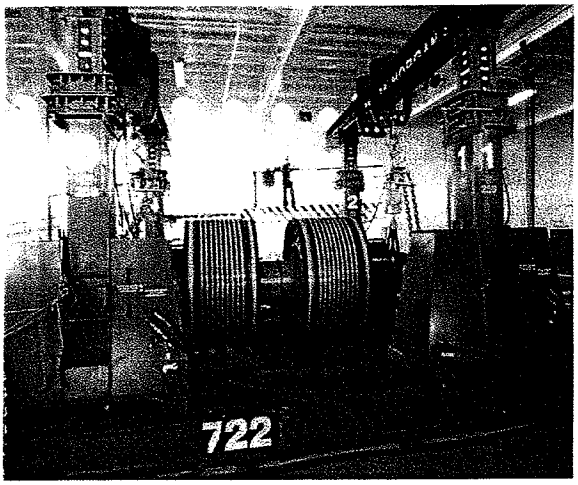


Armature lifted from drive motor room

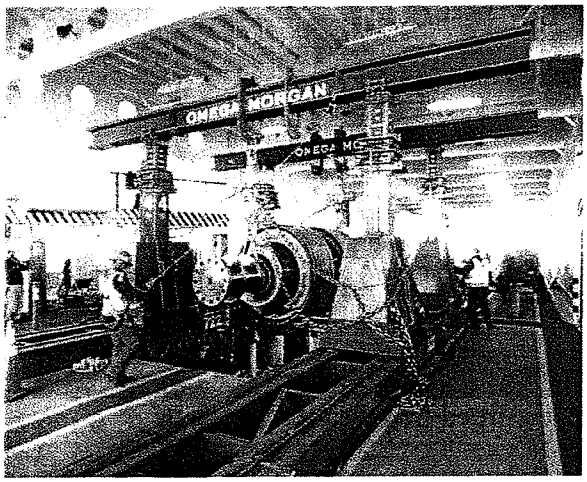
Walla Walla Drive Motor Repair



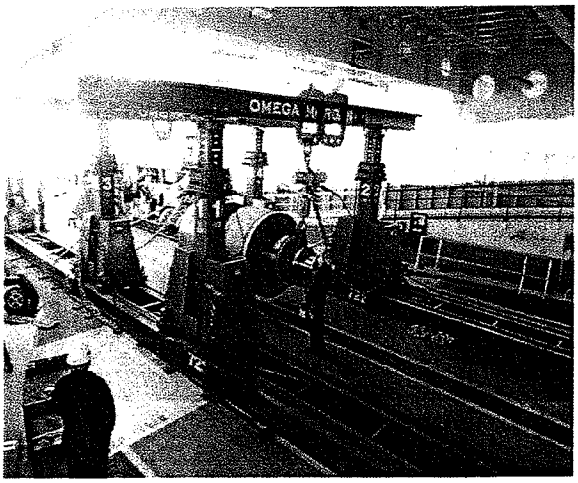
Armature lifted at car deck level



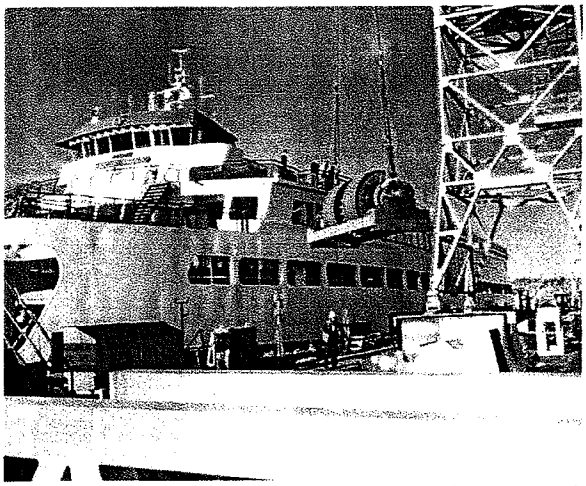
Armature at car deck level ready for move by heavy lift gear to end of vessel



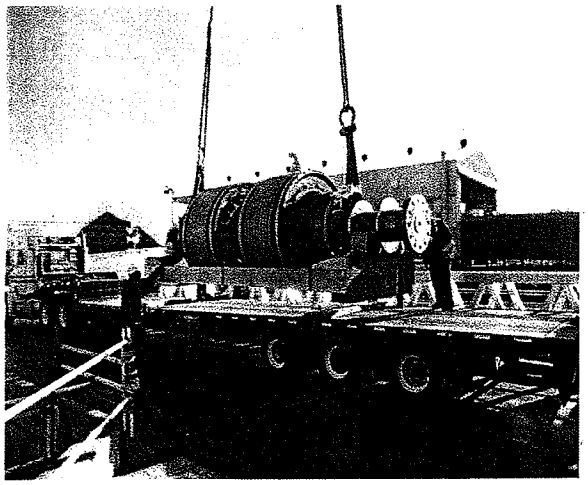
Armature moved by heavy lift gear to end of vessel



Armature moved by heavy lift gear to end of vessel



Armature lifted by shipyard crane off of vessel



Armature loaded onto cradle on trailer

High Technology Solutions for the Producers, Distributors and Users of Electric Power

Cadick Corporation

Engineering Investigation Report

WSDOT#01-2012
January 4, 2013

Elizabeth Nicoletti
Washington State Ferries
Senior Port Engineer
2901 3rd Ave, Suite 500
Seattle WA 98121

Subject: Ferry Walla Walla 1A Propulsion Motor Incident

Dear Elizabeth:

Cadick Corporation is pleased to provide our Technical Investigation Report into the circumstances and findings found regarding the incident that occurred on the M/V Walla Walla on November 4, 2012 while moored at Washington States Maintenance facility at Eagle Harbor.

Contents

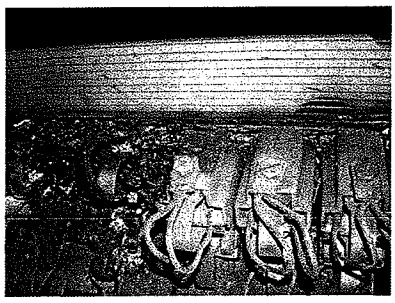
Executive Summary

On November 4, 2012, the vessel Walla Walla was moored at Eagle Harbor Maintenance facility, undergoing propulsion system maintenance. The 1A propulsion motor suffered severe overheating and damage to its armature (see Figures 1, 2, and 3). This incident happened due to a breakdown in communication between the maintenance crew and vessel engineers, lack of system understanding and written procedures and an overly ambitious schedule, attempting to accomplish more than reasonably possible.

The maintenance task at the time of the incident was to stone the commutator of the 2B propulsion motor. There are two motor armatures coupled together at each end of the vessel. The correct procedures were followed on the #2 end, removing all brushes on the 2B motor and using the 2A motor to rotate the armature to be polished. The 1A motor on the other end of the vessel had two sets of brushes down on the commutator and had not been isolated from the A propulsion loop.

The 1A motor was scheduled to have maintenance done after the 2B stoning procedure was completed. Because two sets of brushes were left in their operational position, voltage was applied to the armature through the brushes while the A propulsion loop was energized and caused significant heat damage.

The Plexiglas covers were all in place on the 1A motor during this incident, containing all arcing that occurred. Because the covers were in place, it eliminated any safety concerns regarding adjacent equipment or personnel. There were no individuals in that space during this maintenance.


Figures 1-3

Findings of Fact

The Walla Walla had undergone a maintenance period in Everett, WA from July 23, 2012 to October 31, 2012 prior to this event and numerous items had been accomplished during that period.

1. Paint restoration and vessel repairs were undertaken.
2. All four propulsion motors were inspected and cleaned by Delta Electric. The inspection included the following:
   a. Verifying brush box spacing and height
   b. Evaluating the condition of the commutators.
   c. Checking air gap measurements on the field windings
3. Delta Electrics report (Attachment 2) concluded that all four motor commutators had uneven discoloration due to atmospheric conditions and uneven brush spring tension. The motors also had a heavy film of carbon dust throughout each machine due to self seating brushes being used.
4. Self seating brushes refer to a grade of brush which is typically a softer carbon composite, which conforms to the commutator surface without physically seating the brush by mechanical means
5. Delta recommended that all brushes be replaced with a self cleaning style of brush, these are typically a harder grade of carbon and do not wear as fast, thus less carbon dust.

Follow up conversations between Staff Chief Engineer Bruce Cooper and Delta Electric lead technician, Antonio Vacca regarding corrective action to restore the commutators' surface condition included the recommendation from Delta to polish/burnish each commutator.

This is an accepted industry practice for restoring a damaged surface for improving the commutation and reducing sparking while the motor is operating. A work request was submitted by Staff Chief Engineer, Bruce Cooper, to have Eagle Harbor maintenance electricians polish/burnish the commutators on the #1 and #2 drive motor commutators and undercut high mica that was found on the 1A motor.

1. The term hand stoning the commutator in the context of this report refers to polishing/burnishing the copper surface.
2. A wooden block that has been cut to conform to the curvature of the commutator is applied to the surface of the commutator while it is rotating, to restore the finished surface of the copper.
3. The term stoning can also be used when an abrasive material, in a solid form is pressed onto the rotating commutator, in front of (in the direction of rotation) newly installed carbon brushes, to help seat the brushes to the commutator curvature.

The Walla Walla was towed back to Eagle Harbor from Everett, so the propulsion motors were not energized nor were the heaters inside the motors. Eagle Harbor maintenance electricians tested the insulation values of each motor prior to starting the scheduled work on the motors and found the insulation values were below acceptable values (less than 1 Meg ohm). All motor heaters were energized to dry the insulation. Drying was anticipated to increase the insulation resistance.

The readings increased to an acceptable level during the next 24 hours, with the lowest reading above 6 Meg ohms. During conversations with Mark Levang (Electrical lead) and Vessel General Foreman, Steve Carpine, we learned that it is normal practice to leave all brushes down on the commutator, but the 1A motor was scheduled for maintenance, so all brushes had been removed except for two sets . These brushes were used for connection points for the insulation test set, tests that were conducted on Saturday, November 3rd.

The following events took place prior to starting the scheduled maintenance.

- On November 1st a meeting was held with the electrician lead Mark Levang, Steve Carpine, Vessel General Foreman, the Port Engineer Scott Mullan, and Staff Chief Engineer Bruce Cooper to review the plan for polishing the 2B motor and undercutting the commutator mica on 1A. All were in agreement with starting the work on November 3rd.
- As described earlier, heat was applied with the fixed space heaters in the motor enclosures.
- The insulation readings improved and it was decided to start the maintenance on Nov 4th.
- All brush boxes were removed from the 2B motor, which was the first motor to be worked on, and all but one positive and one negative set of brushes had been removed earlier from the 1A motor.
- It was agreed that the excitation for the 1A & 1B motors would be de-energized, tagged and locked out while the 2B motor commutator was being hand stoned.
- The vessel was positioned so that the #2 end shaft was pushing the vessel into the moorings. Captain Cynthia Bruner was stationed on the bridge, to observe the vessels movement and position while this maintenance was being conducted.

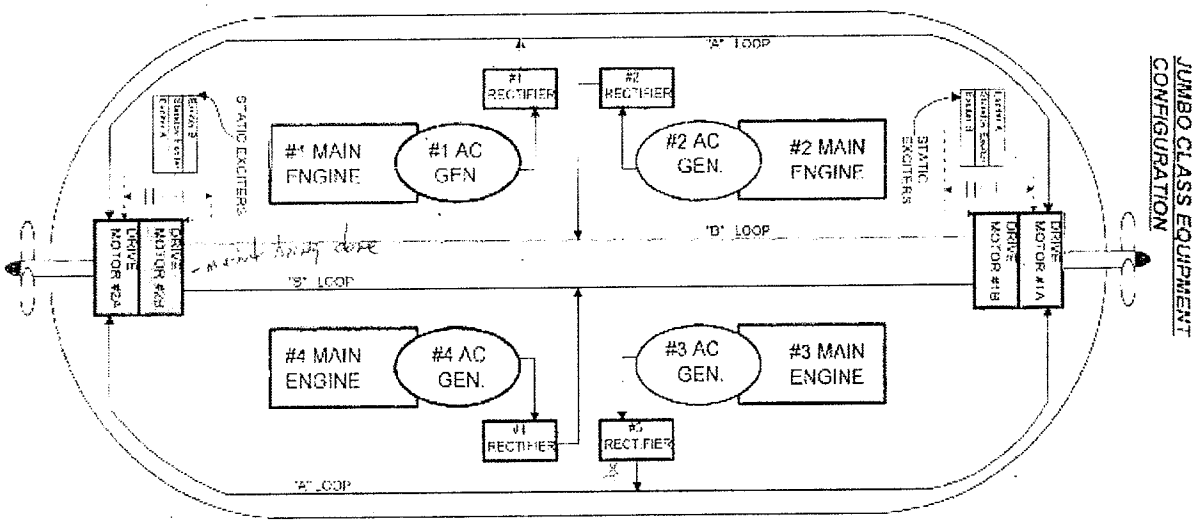


Figure 2

The figure above is being used to illustrate the electrical configuration of the Walla Walla. It is not intended for this diagram to depict the actual physical layout of the vessel. As shown in Figure 2, the Jumbo Class propulsion configuration (Walla Walla) is designed with two propulsion loops. The #3 Main Engine/Generator was providing power to the "A" loop, so that they could turn the #2B motor with the energized 2A motor that was assigned to the A loop. The brushes were all lifted on the 2B motor in order to hand stone the commutator.

The electricians assumed that with the excitation deenergized and tagged/locked out, the 1A motor which is also part of the A loop, would be OK while still in that loop.

The Staff Chief Engineer, Bruce Cooper, opened all the switches for the 1A & 1B motor exciters, tagged and locked out the power to the exciter cabinets for the 1A & 1B motors; see Figure 3.

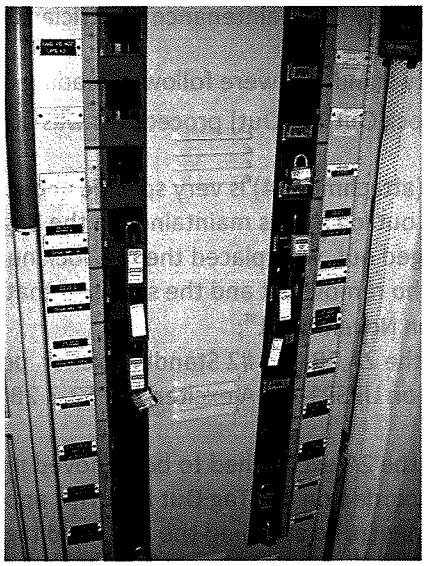


Figure 3

Once the system tag outs were completed by the Staff Chief Engineer (see Attachment 3 – tag out log), the keys for those applied locks were placed in a lock out box and locked by the maintenance electricians, who held the key. This insures that the locks applied by the Chief cannot be removed until the electricians were completed with their work.

- Staff Chief Engineer Bruce Cooper had control of the throttles and plant set up on the day the commutator hand stoning was to be accomplished. The #3 engine was powering the A loop and the throttle was advanced to 40 shaft RPM. Once the shaft reached 40 rpm, Bruce Cooper left the control room and went to the #2 motor room to observe the hand stoning procedure.
- ASCE John Settles assumed control in the Engineering Control room while Bruce Cooper was absent.
- Within seven minutes of rotating the #2 end shaft, the 1A motor High exhaust air temp alarm sounded. At approximately the same time the oiler, Steve Sourelos, ran through the control room and stated there was arcing and smoke coming from the 1A motor.

- The #3 engine/generator was immediately removed from the propulsion loop and the motor room camera was turned on to observe the 1A motor.
- Once the power was removed from the 1A motor the arcing subsided.
- The motor room was vented to the atmosphere to clear the smoke, and after approximately two hours the crew went down and removed the Plexiglas cover from the motor to observe the interior and witnessed the damage to the commutator where the brushes had been left down on the commutator.
- All work was suspended at that time and the Port Engineer, Scott Mullan was notified of the incident.

The Jumbo Class propulsion system is a fixed armature circuit and can only be isolated by physically reconfiguring a set of bus links in each motor enclosure to isolate the motors armature from the bus loop. This would have to be done in order to energize only one motor on a particular loop and not the other motor. It is our opinion that this was not understood by the maintenance electricians.

To verify that all precautions and Safety standards were followed leading up to this incident, a thorough review of WFS Safety Instruction and LOTO (Lock Out Tag Out) procedures was accomplished.

- The Lock out Tag Out Manual (attachment 4) is very specific about the procedures to be followed to isolate a given circuit. The Tag out log that is maintained in the Engineering Control Room documents what equipment has been tagged out, who placed the tag, lock number and the date. It also indicates when the tag was removed, who removed it and the status of that piece of equipment.
- Our investigation found that on November 1st;
    - Locks were placed on the 2A,2B and #2 Standby exciter power circuit breakers.
    - Tags were also placed on UPSP1-4, 2A exciter, USPS2-3 2B exciter and USPS2-5 #2 Standby exciter.
    - The locks and tags for the 2A exciter had to be removed prior to energizing this motor, but they were never cleared/recorded on the Tag Out Log. This appears to be an administrative oversight by the Staff Chief Engineer who attached the locks and tags.
- What was apparent was the lack of communication between the maintenance crew and the Staff Chief Engineer regarding the steps each one took to prepare for the planned maintenance.
- Without a written document that details this maintenance evolution, the electricians rely on the Chief Engineer to properly lock out and tag out the propulsion system in a manner which eliminates any release of hazardous energy or exposes anyone to an unsafe condition.
- Because the maintenance crew is not familiar enough with the vessels propulsion system to know if the tag out was thorough, they rely on the Chief to make sure that is tagged out correctly. This maintenance task had not been done on the Walla Walla for 10 years prior to this attempt
- The electricians stated that they have done this type of maintenance many times on the other classes of vessels, but this was the first time for most of them on this vessel.
- Electrician Mark Levang is the only maintenance electrician who has done this procedure before on the Walla Walla, however he was not the lead electrician at the time.

Because the propulsion motors on the Walla Walla are connected to each propulsion loop through bus links, the motors are not isolated from propulsion voltage when their respective exciters are taken out of service.

Figure 4 shows the links that are located in an enclosure which is attached to each motor. If a motor has to be isolated completely from the energized propulsion loop, these links must be removed and repositioned so that the loop stays closed, going around the motor circuit and isolating the motor armature from the loop voltage.

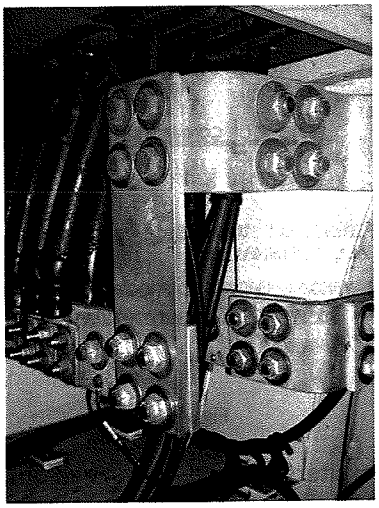


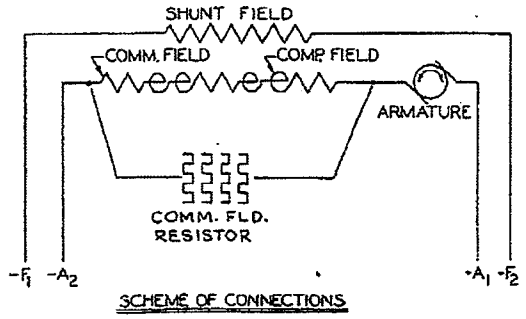
Figure 4

Conclusions

Because the 1A motor had two sets of brushes still connected to the commutator and the loop isolation links still "in service", the A loop voltage was applied to that motor's armature circuit, the commutating (interpole) windings and compensating (pole face) windings.

It is our opinion that there were four (4) proximate issues that led to this failure.

1. Insufficient communications among all involved personnel the day of the casualty.
2. The SCE Bruce Cooper was not aware that the brushes had been removed from the 1A motor
3. Insufficient understanding of the motor electrical supply system resulting in a failure to properly disconnect the 1A motor armature or discuss the possible alternate set up as described earlier
4. A rushed schedule in an attempt to finish the work quickly and get the ferry restored to service.



NOTES.

1. IT IS PERMISSIBLE TO REVERSE SIMULTANEOUSLY THE POLARITIES OF ALL TERMINALS.
2. ROTOR WINDING-BACKWARD PROGRESSION, INVOLUTE RISERS.
3. PLACE A POSITIVE BRUSH UNDER NORTH POLE.

Figure 5

- Figure 5, shows that -- with the exciters secured and tagged out, if the propulsion A loop is energized, power is present at the A1 and A2 connections. Connections A1 and A2 can only be disconnected by opening the links as previously discussed.
- With only two sets of carbon brushes in place on the commutator and no excitation applied to the field (F1, F2) the motor would not develop enough torque to break free.
- We believe that the damaged brush set (negative polarity) initially had a higher resistance than thepositive set. When the voltage was applied, current flowed through both brush sets; however, the higher resistance of the negative brushes caused it to more rapidly heat up. As its temperature increased over that of the positive set, its relative resistance increased as did the voltage across it. This heat-resistance relationship caused the negative brush set to reach the melting point of copper much faster than the positive brush set. The resulting arcing caused a reduction in the total current; and at that point, the positive brush set would have experienced decreasing heat dissipation and never reached the point of obvious damage.
- This entire evolution, from energizing the A loop to shutting it down after smoke and arcing were observed coming from the 1A motor, lasted approximately seven minutes, as recorded by the ships alarm and monitoring system (attachment 5).

Recommendations

We recommend that the following steps be taken to reduce the possibility of a reoccurrence of this type of incident:

Develop a written procedure which details every aspect of a particular task.

It has been noted several times in this report that there is no written procedure for some of the maintenance performed on this vessel. A written procedure, similar to those used by the Naval Sea services and many of the large bulk carrier companies, is highly recommended.

Such a procedure details every aspect of a particular task, and includes all safety related requirements, such as Lock Out Tag Out procedures and Personal Protective Equipment required to perform the job. These procedures should be created as a joint effort, between a vessel engineer, Eagle Harbor maintenance personnel and an outside vendor, who is practiced at creating this type of document. At a minimum the procedure should include the following:

- A specific schedule for each task including the time required for completion.
- The number of technicians required.
- The skill set and experience required for each technician.
- All required tools and equipment.
- All hazards that may be encountered.
- Step-by-step directions need by all involved.
- Each item on the procedure should have a check box so that the person in charge can check off each step as it is accomplished.
- List the components that are being locked out not the system it is part of.

This document would cover all of the tasks required of vessel personnel, maintenance personnel and or outside contractors.

Had this type of Maintenance Procedure document been available,

1. The Chief Engineer would have known that the maintenance team had left brushes down on the 1A motor for insulation tests.
2. The maintenance team would have realized that the bus links needed to be removed prior to energizing the propulsion loop and that just securing the exciters was not enough.
3. The Port Engineer's Department would have been aware of each step and time required to accomplish that maintenance task.
4. Planning Depts. would have a better understanding of the time and assets required to complete a specific task and could plan this maintenance with a more reasonable time of completion.

Because this type of maintenance is rarely done, relying totally on corporate knowledge is not recommended. While each individual involved in this incident did what they knew needed to be done, there was a missing

factor which lead to this incident, a common reference that all involved could rely on, a procedure that had been tested and proven.

The creation of the Maintenance Procedures should include a member of each of the specialties that are responsible for that work or anyone tasked with oversight.

Provide additional training for maintenance and safety personnel.

Cadick Corporation has reviewed the Training Course for the Jumbo Class Ferry Propulsion System. This manual is a very good technical reference, but does not discuss system configuration and set up in much detail. It is designed for the engineer who has a fair to excellent knowledge base of the system already.

We envision a short training program of perhaps eight (8) hours in length. During this training, all involved personnel would be walked through the procedure for the task(s) to be performed. It should include a brief, detailed coverage of the expected safety hazards and how they can be avoided.

In addition to the eight hour training, we also recommend that annual training be implemented for affected personnel including:

1. Coverage and review of all ship's electrical systems.
2. Review of safety procedures and policies.
3. Selected focus on issues or problems that have appeared in the period since the last training.

The provision of these types of training will help to keep personnel more focused on the technical and safety aspects of their jobs. It will also help to keep morale high.

We believe that the implementation of these recommendations will greatly reduce the possibility of a recurrence of problems such as those that are the topic of this report.

Respectfully submitted:

Micheal Turner
Director of Marine Services
Cadick Corporation

Recognition Statement

Cadick Corporation would like to express its appreciation for the support and candor of all personnel that were involved in our investigation. We are pleased to note that all personnel focused on the analysis and resolution of the problem with an eye towards implementing procedures to prevent its recurrence.

We would especially like to thank:

From the Investigation Kick Off Meeting 11/13/12:

- Elizabeth Nicoletti
- Tim Browning
- Scott Mullan
- Ron Wohlfrom
- Mike Lindsey
- Vern Day
- Dan Gleaves
- David Gleaves
- RJ Kelly
- Darnell Baldinelli
- George Capacci
- Jean Baker
- Steve Rodgers

Other Individuals with Whom We Discussed the Incident

- Bruce Cooper
- Mike Lindsey
- Mark Levang
- Steve Carpine
- Delta Electric – Tony Vacca

Attachments

Delta Electrics Report

Tag Out Log

Lock Out Tag Out Manual

Ship's Alarm and Monitoring System

Statements

Motor Outline

Engineering Investigation Report

WSDOT#01-2012
February 16, 2013

Elizabeth Nicoletti
Washington State Ferries
Senior Port Engineer
2901 3rd Ave, Suite 500
Seattle WA 98121

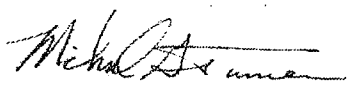
Subject: Follow up statement for the Ferry Walla Walla 1A Propulsion Motor Incident Report

Dear Elizabeth:

Cadick Corporation would like to acknowledge that some information became available to us after we had published our findings and conclusions for the Ferry Walla Walla motor incident.

Prior to the Vigor Everett shipyard period, the Walla Walla was scheduled for two weeks of annual maintenance and US Coast Guard inspections at the Eagle Harbor Repair Facility once the vessel was redelivered. This two week scope of work (approximately 553 scheduled Eagle Harbor work hours) was changed to two and one half weeks (approximately 873 scheduled Eagle Harbor work hours) in order to accomplish the drive motor work.

Respectfully submitted:



Micheal Turner
Director of Marine Services
Cadick Corporation